```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import re
import os
import sklearn
import tqdm
from tqdm import tqdm
import nltk
import warnings
warnings.filterwarnings("ignore")
import cv2
from sklearn.model_selection import train_test_split
import PIL
from PIL import Image
import time

import tensorflow as tf
import keras
from keras.layers import Input,Dense,Conv2D,concatenate,Dropout,LSTM
from keras import Model
from tensorflow.keras import activations
import warnings
warnings.filterwarnings("ignore")
import nltk.translate.bleu_score as bleu
from keras.models import load_model
```

```
from google.colab import drive
drive.mount('/content/drive')
```

```
     Mounted at /content/drive
```

```
os.chdir("/content/drive/My Drive/cs2")
```

FINAL FUNCTION

```
def beam_search(image_1,image_2, beam_index):
  # this function will take the input images from the test data and beam index and gives t
      import warnings
      warnings.filterwarnings("ignore")
      #loading the pretrained chexnet model for getting image features
      final_chexnet_model=load_model("chexnet_final.h5")
      #loading embedded matrix
      embedding_matrix=np.load('Embedding_matrix.npy')
      #Loading the pretrained tokenizer
      import pickle
      with open('tokenizer_1.pkl', 'rb') as handle:
        token= pickle.load(handle)
      enc_units=64
      embedding_dim=300
```

```
dec_units=64
att_units=64
max_len = 100
bs = 10
vocab_size = 1427
class encoder_decoder(tf.keras.Model):
    def __init__(self,enc_units,embedding_dim,vocab_size,output_length,dec_units,att_
          super().__init__()


          self.batch_size=batch_size
          self.encoder =Encoder(enc_units)
          self.decoder=Decoder(vocab_size,embedding_dim,output_length,dec_units,att_


          #Compute the image features using feature extraction model and pass it to 
         # This will give encoder ouput
        # Pass the decoder sequence,encoder_output,initial states to Decoder
        # return the decoder output


    def call(self, data):
        features,report  = data[0], data[1]

        encoder_output= self.encoder(features)
        state_h=self.encoder.initialize_states(self.batch_size)

        output= self.decoder(report, encoder_output,state_h)

        return output
#encoder model
#https://www.tensorflow.org/tutorials/text/nmt_with_attention
class Encoder(tf.keras.Model):
  def __init__(self,units):
    super().__init__()
    self.units=units


  def build(self,input_shape):
    self.dense1=Dense(self.units,activation="relu",kernel_initializer=tf.keras.initi
    self.maxpool=tf.keras.layers.Dropout(0.5)

  def call(self,input_):
    enc_out=self.maxpool(input_)
    enc_out=self.dense1(enc_out)

    return enc_out
 #https://www.tensorflow.org/tutorials/text/transformer#decoder
class Decoder(tf.keras.Model):
    def __init__(self, vocab_size, embedding_dim, output_length, dec_units,att_units
        super().__init__()
  #Intialize necessary variables and create an object from the class onestepdecoder
        self.onestep=One_Step_Decoder(vocab_size, embedding_dim, output_length, dec_
    def call(self, input_to_decoder,encoder_output,state_1):

         #Initialize an empty Tensor array, that will store the outputs at each and
         #Create a tensor array as shown in the reference notebook

         #Iterate till the length of the decoder input
        # Call onestepdecoder for each token in decoder_input
       # Store the output in tensorarray
     # Return the tensor array

        all_outputs=tf.TensorArray(tf.float32,input_to_decoder.shape[1],name="output
        for step in range(input_to_decoder.shape[1]):
            output,state_1,alpha=self.onestep(input_to_decoder[:,step:step+1],encode

            all_outputs=all_outputs.write(step,output)
        all_outputs=tf.transpose(all_outputs.stack(),[1,0,2])

        return all_outputs
#this is the attention class.
#Here the input to the decoder and the gru hidden state at the pevious time step are given
#This context vector is calculated uisng the attention weights. This context vector is the
#Here conact function is used for calaculating the attention weights
class Attention(tf.keras.layers.Layer):
    def __init__(self,att_units):

      super().__init__()

      self.att_units=att_units

    def build(self,input_shape):
        self.wa=tf.keras.layers.Dense(self.att_units)
        self.wb=tf.keras.layers.Dense(self.att_units)
        self.v=tf.keras.layers.Dense(1)


    def call(self,decoder_hidden_state,encoder_output):

      x=tf.expand_dims(decoder_hidden_state,1)

      alpha_dash=self.v(tf.nn.tanh(self.wa(encoder_output)+self.wb(x)))

      alphas=tf.nn.softmax(alpha_dash,1)

      context_vector=tf.matmul(encoder_output,alphas,transpose_a=True)[:,:,0]
      # context_vector = alphas*encoder_output
      # print("c",context_vector.shape)


      return (context_vector,alphas)
 #This class will perform the decoder task.
 #The main decoder will call this onestep decoder at every time step. This one step
 #This output is passed through the final softmax layer with output size =vocab size
class One_Step_Decoder(tf.keras.Model):
  def __init__(self,vocab_size, embedding_dim, input_length, dec_units ,att_units):
```

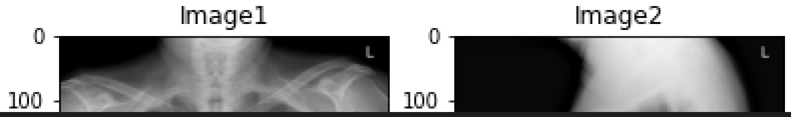
```
      # Initialize decoder embedding layer, LSTM and any other objects needed
    super().__init__()

    self.att_units=att_units
    self.vocab_size=vocab_size
    self.embedding_dim=embedding_dim
    self.input_length=input_length

    self.dec_units=dec_units
    self.attention=Attention(self.att_units)
    #def build(self,inp_shape):
    self.embedding=tf.keras.layers.Embedding(self.vocab_size,output_dim=self.embeddi
                                       input_length=self.input_length,mask_zero=True

    self.gru=tf.keras.layers.GRU(self.dec_units,return_sequences=True,return_state=T
    self.dense=tf.keras.layers.Dense(self.vocab_size,name="decoder_final_dense")
    self.dense_2=tf.keras.layers.Dense(self.embedding_dim,name="decoder_dense2")


  def call(self,input_to_decoder, encoder_output, state_h):

    embed=self.embedding(input_to_decoder)

    context_vector,alpha=self.attention(state_h,encoder_output)

    context_vector=self.dense_2(context_vector)

    result=tf.concat([tf.expand_dims(context_vector, axis=1),embed],axis=-1)


    output,decoder_state_1=self.gru(result,initial_state=state_h)
    out=tf.reshape(output,(-1,output.shape[-1]))

    out=tf.keras.layers.Dropout(0.5)(out)

    dense_op=self.dense(out)

    return dense_op,decoder_state_1,alpha

def image_feature_extraction(image_1,image_2):
  #gets the features of the given image from pretrained chexnet model
  image_1 = Image.open(image_1)
  image_1= np.asarray(image_1.convert("RGB"))

  image_2=Image.open(image_2)
  image_2 = np.asarray(image_2.convert("RGB"))

  #normalising the image
  image_1=image_1/255
  image_2=image_2/255

  #resize the image into (224,224)
  image_1 = cv2.resize(image_1,(224,224))
  image_2 = cv2.resize(image_2,(224,224))
  image_1= np.expand_dims(image_1, axis=0)
  image_2= np.expand_dims(image_2, axis=0)

#now we have read two image per patient. this is goven to the chexnet model for feat

  image_1_out=final_chexnet_model(image_1)
  image_2_out=final_chexnet_model(image_2)
  #conactenate along the width
  conc=np.concatenate((image_1_out,image_2_out),axis=2)
  #reshape into(no.of images passed, length*breadth, depth)
  image_feature=tf.reshape(conc, (conc.shape[0], -1, conc.shape[-1]))

  return image_feature
model  = encoder_decoder(enc_units,embedding_dim,vocab_size,max_len,dec_units,att_un
#loading the weights
model.load_weights("model_3/wts")

hidden_state =  tf.zeros((1, enc_units))
image_features=image_feature_extraction(image_1,image_2)

def take_second(elem):
  return elem[1]

encoder_out = model.layers[0](image_features)

start_token = [token.word_index["<sos>"]]
dec_word = [[start_token, 0.0]]
while len(dec_word[0][0]) < max_len:
    temp = []
    for word in dec_word:

        predict, hidden_state,alpha = model.layers[1].onestep(tf.expand_dims([word[0


        word_predict = np.argsort(predict[0])[-beam_index:]
        for i in word_predict:

            next_word, probab = word[0][:], word[1]
            next_word.append(i)
            probab += predict[0][i]
            temp.append([next_word, probab.numpy()])
    dec_word = temp
    # Sorting according to the probabilities scores


    dec_word = sorted(dec_word, key=take_second)

    # Getting the top words
    dec_word = dec_word[-beam_index:]


final = dec_word[-1]

report =final[0]
```

```
      score = final[1]
      temp = []

      for word in report:
        if word!=0:
          if word != token.word_index['<eos>']:
              temp.append(token.index_word[word])
          else:
              break

      rep = ' '.join(e for e in temp)

      return rep, score
```

```
def test():
  import random
  start=time.time()

  test_dataset = pd.read_csv('test_data_final.csv')
  i=int(input('enter a number from under 399'))
  if i <= 399:

    img1=test_dataset.iloc[i]["Image-1"]
    img2=test_dataset.iloc[i]["Image-2"]
    #show th corresponding x-ray images
    i1=cv2.imread(img1)
    i2=cv2.imread(img2)
    plt.figure(figsize=(10,6))
    plt.subplot(131)
    plt.title("Image1")
    plt.imshow(i1)
    plt.subplot(132)
    plt.title("Image2")
    plt.imshow(i2)
    plt.show()
    #printing the actual and generated results

    result,score=beam_search(img1,img2,3)
    actual=test_dataset.iloc[i]['Findings']
    actual_ref = actual.split()
    result_ref = result.split()


    print("ACTUAL REPORT: ",actual)
    print("GENERATED REPORT: ",result)
    end=time.time()
    print("BLEU SCORE IS: ",bleu.sentence_bleu(actual_ref,result_ref,weights=(0.25,0.25,0.

    print("time required for the evaluation is ",end-start)
    print('time required for the evaluation is',end-start)

  else:
    print('The point does not exist')
```

```
#random point
Score = test()
```

```
enter a number from under 3999
```



```
score = test()
```

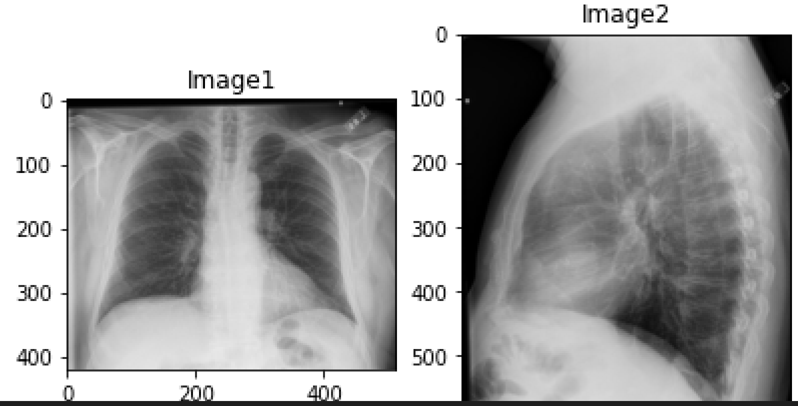
```
enter a number from under 399100
```

```
#for a point not in list
test()
```

```
enter a number from under 399577
The point does not exist
```

```
#for 0 th point
test()
```

```
enter a number from under 3990
```



```
WARNING:tensorflow:No training configuration found in the save file, so the model was
WARNING:tensorflow:Unresolved object in checkpoint: (root).optimizer
WARNING:tensorflow:Unresolved object in checkpoint: (root).optimizer.iter
WARNING:tensorflow:Unresolved object in checkpoint: (root).optimizer.beta_1
WARNING:tensorflow:Unresolved object in checkpoint: (root).optimizer.beta_2
WARNING:tensorflow:Unresolved object in checkpoint: (root).optimizer.decay
WARNING:tensorflow:Unresolved object in checkpoint: (root).optimizer.learning_rate
WARNING:tensorflow:Unresolved object in checkpoint: (root).optimizer's state 'm' for
WARNING:tensorflow:Unresolved object in checkpoint: (root).optimizer's state 'm' for
WARNING:tensorflow:Unresolved object in checkpoint: (root).optimizer's state 'm' for
WARNING:tensorflow:Unresolved object in checkpoint: (root).optimizer's state 'm' for
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```